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CRASHWORTHY CONFIGURATION OF A PASSAGE FOR RAILWAY VEHICLES WITH INTEGRATED ANTICLIMBER PILE-UP PREVENTION FOR RAILWAY CARS

The invention relates to interconnected train cars with at least two rail vehicles, which are coupled to each other and between which an all-around closed passage is provided with at least two gangway bellows that can be connected to each other and that each have several bellows frames, and the passage further has passage plates and a support for the passage plates, with this support being able to move on a sliding plate arranged between the railway car by means of a coupling device, wherein at least one pile-up prevention device is provided on the ends of the rail vehicles coupled to each other.

In the case of a rear-end collision accident between two rail vehicles, there is the risk that a car body of a rail vehicle with a height offset will slide over another car and cause severe damage in the passenger compartment. This risk exists not only for the colliding front or end vehicles, but also for the interconnected vehicles in a train. To prevent the risk of pile up, typically pile-up prevention devices are installed. These pile-up prevention devices, so-called "anticlimbers," are installed not only at the ends of the train, but also at the ends of the cars located within the interconnected train cars.

Typically, pile-up prevention devices have several parallel and horizontal ribs, with the pile-up prevention devices of two colliding cars engaging with each other in comb-like fashion. The pile-up prevention devices are conventionally arranged at the longitudinal ends of the solebar of the underframe of a rail vehicle, so that in the case of a collision, force can be introduced into the load-bearing area of the car. Such a pile-up prevention device became known, for example, from US 4,184,434 A.

In the region of the coupling, the pile-up prevention device in rail vehicles is typically interrupted. Furthermore, the pile-up prevention device can optionally have a lining, e.g., made from glass fiber-reinforced plastic, which, in the case of a collision, is crushed before the mutual engagement of the two pile-up prevention devices.

Known pile-up prevention devices almost always compete with the coupling, because when the coupling height and the height of the car bottom are fixed, usually there is little space remaining for a pile-up prevention device under consideration of the coupling movements. This fact is shown, e.g., in the article "Production of rail vehicles" in ZEV + DET Glas. Ann. 123 (1999).

In trains of interconnected cars of the type named above, in which several rail vehicles are coupled to each other and all-around closed passage devices are provided to enable passengers to change from one car to another, when anticlimbers are used, the problem arises, as already mentioned above, that there is only very little installation space available. Due to the

small installation space, which is limited first by means of the floor height and second by means of the height of the solebar at whose longitudinal ends the anticlimber is arranged, the arrangement of an interconnected anticlimber over the entire vehicle width with the known all-around closed passage devices is impossible.

A disadvantage of anticlimbers that do not run over the entire vehicle width is primarily that in the case of a collision, the anticlimbers of the colliding vehicles can be displaced laterally relative to each other, which can reduce the effectiveness of the pile-up prevention devices.

One problem of the invention is to devise a passage device or interconnected train cars, in which the above-mentioned disadvantage is eliminated as much as possible.

This problem is solved according to the invention with interconnected train cars of the type named above, such that the pile-up prevention devices each run essentially over the entire vehicle width, the bottom edges of the bellows frames are arranged above the upper edges of the pile-up prevention devices, and the sliding plates, especially including the solid parts of the passage support, are arranged under the bottom edges of the pile-up prevention devices.

The passage is connected to the car body in the region under the bridge plates. In particular, the bottom edge of one end bellows frame of each gangway bellows is connected to the car body via at least one bottom profile arranged under the base region of the passage and above the upper edge of the pile-up prevention devices in front of a car body of one of the railway cars. Here, this bottom profile is shaped so that it is suitable in its size to be able to manage with the available installation space. This objective can be realized in that the bottom profile has a Z-shaped cross section. Also, the top side and the side regions of the passage are connected to the car body with profiles. However, in terms of installation size, no special requirements are placed on the shape of these profiles.

The wear of the support can be reduced and thus its service life can be increased by manufacturing the sections of the support interacting with the sliding plate from steel.

In order not to prevent the engagement of the anticlimbers in the case of a collision, the support can be built from aluminum in its vertical section, which extends in an installed state essentially orthogonal to the plane of the rails and which is set between the pile-up prevention devices. Due to this embodiment, the parts arranged between the anticlimbers are significantly softer than the anticlimbers and thus do not prevent their engagement in the case of a collision.

To provide the necessary space for the block of the all-around closed gangway bellows arranged between the two rail vehicles in the case of a collision, and thus to guarantee a secure engagement of the two anticlimbers, the load-bearing structure of the end of each rail vehicle is set back to the end regions coupled to each other in the longitudinal direction of the vehicle, wherein profiles made from a more deformable material than the load-bearing structure of the end wall are mounted in front of the load-bearing structure. Thus, the profiles placed in front of

the load-bearing structure can collapse in the case of a crash, and the necessary space for the block length of the passage can be provided. Here, the block length is understood to be the length of the compacted gangway bellows.

The invention, including the additional advantages, is explained in more detail below with reference to a few non-restricting embodiments, which are shown in the drawings. In this drawing, the single figure shows a schematic view of a cross section along the longitudinal axis of the interconnected train cars according to the invention.

According to the shown embodiment, the interconnected train cars ZUV according to the invention have at least two vehicles WA1, WA2 coupled to each other via a coupling KUP. Each of the two vehicles WA1, WA2 has at one longitudinal end a pile-up prevention device AC1, AC2, which runs essentially over the entire vehicle width and which is preferably produced from steel. Here, the pile-up prevention device AC1, AC2 of each car WA1, WA2 can be connected to the underframe via the longitudinal ends of solebars LT1, LT2 of the underframe. In the embodiment shown here, forces are introduced from the pile-up prevention devices AC1, AC2 via the end surfaces of the solebars LT1, LT2 into the underframe, with force being introduced into the underframe not exclusively via the ends of the solebars, but also in the middle via solebars, which are connected to the main transom and which also include the interface to the coupling.

Between the rail vehicles WA1, WA2, there is a passage UEB, which has an all-around closed gangway bellows consisting of at least two parts WB1, WB2; namely a first gangway bellows WB1 allocated to the car WA1 on the left in the drawing and a second gangway bellows WB2 allocated to the car WA2 on the right in the drawing. The gangway bellows WB1, WB2 can be connected to each other at their ends EN1, EN1 allocated to each other. Here, each bellows WB1, WB2 can have, for example, an end frame not shown here, wherein these frames can be screwed to each other or connected via another coupling mechanism. The gangway bellows WB1, WB2 each have parallel bellows frames BR1, BR2, BR3, BR4, which are preferably produced from aluminum. In the drawing, these bellows frames BR1, BR2, BR3, BR4 are indicated by dotted lines. Here a bellows frame BR1, BR2, BR3, BR4 is located between two undulations of the gangway bellows WB1, WB2. The function of the bellows frames BR1, BR2, BR3, BR4 is to maintain the structure of the gangway bellows and to interconnect the undulations of the gangway bellows. The bellows frames BR1, BR2, BR3, BR4 are arranged so that the bottom edges of the bellows frames BR1, BR2, BR3, BR4 come to lie above the upper edges of the pile-up prevention devices AC1, AC2. This configuration prevents the bellows frames BR1, BR2, BR3, BR4 from obstructing the engagement of the pile-up prevention devices AC1, AC2 if there is a collision.

To enable the arrangement of the bellows frames BR1, BR2, BR3, BR4 above the pile-up prevention devices AC1, AC2, the bottom edge of a car body-side, end bellows frame BR1, BR4 of each gangway bellows WB1, WB2 is connected to the car bodies WK1, WK2 via a profile PR1, PR2 arranged under the base region of the passage UEB and above the upper edge of the pile-up prevention devices AC1, AC2 in front of a car body WK1, WK2 of one of the rail vehicles WA1, WA2. The use of narrow profiles PR1, PR2 as screw-on frames in the horizontal base region of the passage enables a simple assembly of the passage UEB above the upper edge of the anticlimbers AC1, AC2. The profiles PR1, PR2 can also be part of a frame mounted on the car bodies WK1 or WK2.

Furthermore, in the passage UEB there are passage plates, so-called bridge plates UB1, UB2, UB3, UB4, wherein two passage plates designated as UB1, UB2, in the following designated as "side passage plates" UB1, UB2, are mounted on a profile WP1, WP2 of the allocated car body WK1, WK2 so that they can each rotate about an axis A, A' parallel to the plane of the rails and normal to the vehicle longitudinal direction, with the passage plates UB1, UB2, UB3, UB4 essentially lying at the level of the floor upper edges FN1, FN2.

Furthermore, the load-bearing structure of the end wall of each railway car WA1, WA2 can be set back at the end regions coupled to each other in the vehicle longitudinal direction. In the installation space opened up by setting this structure back, profiles WP1, WP2 made from a more deformable material than the load-bearing structure of the end wall are installed on both sides of an opening into the car bodies WK1, WK2, through which a passenger can move from one vehicle WA1, WA2 to the other by means of the passage UEB. The side passage plates UB1, UB2 can be mounted in the way described above onto these profiles WP1, WP2, as is visible from the drawing.

Through the arrangement of profiles WP1, WP2 made from a more deformable material, for example, aluminum, than the load-bearing structure of the end wall, which can be produced from steel, in the case of a crash, the softer profiles WP1, WP2 deform, which creates the necessary space for the block length of the passage UEB.

A support ABS for a middle passage plate or middle passage plates UB3, UB4 are arranged above the coupling middle KPM of the two rail vehicles WA1, WA2. The support ABS can be integrated with the middle passage plate at its upper region. The side passage plates UB1, UB2 arranged on the car bodies WK1, WK2 lie on this passage plate or passage plates UB3, UB4. The free ends of the middle passage plate or the passage plates UB3, UB4 can be beveled and lie under the side passage plates UB1, UB2. Thus, the side passage plates UB1, UB2 are supported on their free ends on the middle passage plates UB3, UB4. By beveling the free ends of the middle passage plates UB3, UB4, a ramp surface for the side passage plates UB1, UB2 is

created, which can compensate for displacements of the two cars WA1, WA2 relative to each other in the vertical and horizontal directions.

The support ABS can move on a sliding plate GLP arranged above the coupling device KUP. The solid section UAB of the support ABS interacting with the sliding plate GLP can be produced from steel in order to improve the wear properties, just like the sliding plate support on which the actual plastic sliding plate is mounted. The sliding plate GLP and the bottom section UAB of the support ABS is arranged according to the invention under the bottom edge of the pile-up prevention devices AC1, AC2. The arrangement of the sliding plate GLP and also the base UAB of the support ABS interacting with the sliding plate are arranged under the pile-up prevention devices AC1, AC2, which can prevent the sliding plate GLP or the base UAB of the support from interfering with the engagement of the pile-up prevention devices AC1, AC2 in the event of a collision.

Furthermore, the support ABS can be made from aluminum in a vertical section MAB, which runs in an installed state essentially normal to the plane of the rails and which is set between the anticlimbers AC1, AC2. This embodiment guarantees that the pile-up prevention devices AC1, AC2 penetrate or deform the vertical middle section MAB made from aluminum, and thus can engage each other in the event of a collision.

In conclusion, it should be mentioned that in the present document, the term rail vehicle is understood to be not only a pulled car, but also a locomotive, although the preferred embodiment of the invention does not present this configuration.

Claims

1. Interconnected train cars (ZUV) with at least two rail vehicles (WA1, WA2) coupled to each other, between which there is a passage (UEB) with at least two gangway bellows (WB1, WB2), which can be connected to each other and which each have several bellows frames (BR1, BR2, BR3, BR4), and the passage (UEB) has additional passage plates (UB1, UB2, UB3, UB4) and a support (ABS) for the passage plates (UB1, UB2, UB3, UB4), with this support being able to move on a sliding plate (GLP) arranged between the rail vehicles (WA1, WA2) above a coupling device (KUP), wherein there is at least one pile-up prevention device (AC1, AC2) on the end regions of the rail vehicles (WA1, WA2) coupled to each other, characterized in that the pile-up prevention devices (AC1, AC2) extend essentially over the entire vehicle width, the bottom edges of the bellows frames (BR1, BR2, BR3, BR4) are arranged above the upper edges of the pile-up prevention devices (AC1, AC2), and the sliding plate (GLP) is arranged under the bottom edges of the pile-up prevention devices (AC1, AC2).

2. Interconnected train cars according to Claim 1, characterized in that the bottom edge of an end bellows frame (BR1, BR2, BR3, BR4) of each gangway bellows is connected to the car body (WK1, WK2) via at least one profile (PR1, PR2) arranged under the base region of the passage (UEB) and above the upper edge of the pile-up prevention devices (AC1, AC2) in front of a car body (WK1, WK2) of one of the railway cars (WA1, WA2).

3. Interconnected train cars according to Claim 2, characterized in that the profile (PR1, PR2) has a Z-shaped cross section.

4. Interconnected train cars according to one of Claims 1 to 3, characterized in that the support (ABS) is manufactured from steel in its bottom sections (UAB) interacting with the sliding plate (GLP).

5. Interconnected train cars according to one of Claims 1 to 4, characterized in that the support (ABS) is formed from aluminum in a vertical section (MAB), which extends in an installed state essentially normal to the plane of the rails and which is set between the pile-up prevention devices (AC1, AC2).

6. Interconnected train cars according to one of Claims 2 to 5, characterized in that the load-bearing structure of the end wall of each rail vehicle (WA1, WA2) is set back in the vehicle longitudinal direction at the end regions coupled to each other, wherein profiles (WP1, WP2) made from a material more deformable than the load-bearing structure of the end wall are mounted in front of the load-bearing structure.